



An Overview of Common Peripheral Vestibular Disorders

*Ebtessam Hamed Nada, Dalia Helal Galhom, * Asmaa Abd AL-aziz Elsayed Mohammad, Nahla Hassan Gad*

Audio-Vestibular Medicine Unit, Department of Otorhinolaryngology, Faculty of Medicine, Zagazig University, Egypt.

Abstract

The ability to maintain posture and orientation is one of the fundamental prerequisites for everyday life. The postural control is dependent on the vestibular, vestibulo-spinal and visual systems. Disorders in any one of these systems can cause a sensation of unsteadiness at dynamic and static conditions. Dizziness is one of the most common complaints reported in physicians' offices. Etiologies of dizziness can be most easily divided into two categories: vestibular and nonvestibular. Nonvestibular causes of dizziness originate outside the vestibular system, including the peripheral nervous and cardiovascular systems. Vestibular causes of dizziness arise from the peripheral or the central vestibular system. The central vestibular system refers to the vestibular components of the brain and brainstem. The peripheral vestibular system refers to the components of the inner ear and the nerves and pathways connecting the inner ear to the central vestibular system. This article explores the most common causes of peripheral vestibular disorders. Three typical forms of peripheral vestibular disorders can be differentiated by their characteristic signs and symptoms: chronic bilateral peripheral loss of vestibular function, characterized by oscillopsia during head movements and instability of gait and posture; acute/ subacute unilateral failure of vestibular function, characterized by a severe rotatory vertigo, oscillopsia, and imbalance; and paroxysmal, inadequate stimulation or inhibition of the peripheral vestibular system, characterized by attacks of vertigo and oscillopsia. The six most frequent forms of peripheral vestibular disorders are benign paroxysmal positioning vertigo (BPPV), Meniere's disease, vestibular neuritis, bilateral vestibulopathy, vestibular paroxysmia, and superior canal dehiscence syndrome.

Keywords: Peripheral vestibular disorders, BPPV, Vestibular Syndromes.

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1. Introduction

Peripheral vestibular disorders are highly morbid conditions that affect 2.8–6.5% of the population (women more frequently than men) and become more prevalent with age. The vestibular apparatus and /or its innervations are the site of pathology in these disorders. Dysfunction of different parts of the peripheral vestibular apparatus presents as several different peripheral vestibular disorders. These can lead to symptoms of dizziness, imbalance, nausea, oscillopsia and occasional falling which can greatly reduce a patient's quality of life. In addition, most patients with chronic symptoms develop depression and anxiety associated with their peripheral vestibular disorder [1]. Consequently, inadequate compensation for vestibular dysfunction severely restricts a person's ability to engage in daily activities like transportation, working, and exercising. These restrictions can cause a decrease in life quality. In addition, the socioeconomic burden of work-related disabilities is substantial [2]. All vestibular symptoms are further classified into vestibular syndromes. Based on the International Classification of Vestibular Disorders (ICVD), these

vestibular symptoms divided into 3 syndromes, namely acute vestibular syndrome (AVS), episodic vestibular syndrome (EVS), and chronic vestibular syndrome (CVS) [3].

2. Vestibular syndromes

Acute Vestibular Syndromes are characterized by spinning vertigo of acute onset that lasts for at least 24 hours, accompanied by oscillopsia, a tendency to fall and nausea. These symptoms are usually precipitated by an acute central or peripheral lesion, resulting in an imbalance between right and left vestibular stimuli [4]. Peripheral causes resulting from AVS are referred to as acute unilateral vestibulopathy and typically result from two main pathologies that affect the vestibulocochlear nerve and vestibular end organs: vestibular neuritis (labyrinthitis if hearing is also involved) and ischemic labyrinthopathy. Central causes refer to mainly posterior circulation stroke but can also involve any lesions along the central vestibular circuitry [5]. Recently, Ibraheem et al [6] reported that COVID-19 virus could affect peripheral vestibular end organ (semicircular canals, saccule, superior and inferior vestibular nerves) but central affection should be

considered. Affection of the auditory system may be due to ischemic damage of the auditory system by causing clot formation in blood vessels of auditory structures by binding to ACE-2 receptor in capillary endothelium to enter cell.

Episodic vestibular syndromes are characterized as transient dizziness lasting seconds to hours, rarely days. It is accompanied by a short duration of nausea, nystagmus and sudden falls. EVS can occur repetitively (episodes) caused by an episodic disorder with repeated spells or as a single event (first manifestation) of a progressive chronic disorder with transient or recurrent dizziness. There are subtypes of EVS with associated triggers (t-EVS) or without triggers (s-EVS, spontaneous EVS). Diagnosis of s-EVS is mainly based on patient's history. Patients with t-EVS have often clinical signs such as positional nystagmus after provocation [7]. Most common disease in EVS is benign paroxysmal positional vertigo (BPPV). It accounts for about 2, 4% of lifetime prevalence and 10% of all the dizziness cases in the emergency department. In s-EVS, Meniere is estimated to be 0, 1% of the population. On the other hand, Vestibular migraine was accounted to be 1% in general population. Vestibular paroxysms are considered a rare disease with uncertain prevalence and predicted to be <1:2000 person in population worldwide [8-9].

Patients with BPPV complain of vertigo with change in head position, rolling over, or getting out of bed and vertigo is often side specific. Vertigo occurs suddenly and lasts mostly for less than 1 minute. Attacks are separated by remissions; however, patients may complain of constant light-headedness between episodes. Classic BPPV involving the posterior semicircular canal is characterized by the following: geotropic nystagmus with problem ear down, predominantly rotary nystagmus toward the undermost ear, latency of a few seconds, duration limited to less than 20 seconds, reversal of nystagmus when patients return to an upright position and a decline in response with repetitive provocation [10]. A dix-hallpike examination is mandatory and can differentiate between a central lesion (atypical nystagmus) leading to central paroxysmal positional vertigo (CPPV) or peripheral (typical nystagmus) leading to BPPV [11]. Meniere's disease is a chronic vestibular disorder that significantly affects the inner ear's delicate balance mechanisms. This condition manifests as recurrent and severe episodes of vertigo, accompanied by symptoms such as fluctuating hearing loss, tinnitus (ringing in ears), and a sensation of fullness in the affected ear.

These symptoms arise due to fluid buildup in the inner ear's labyrinth, which houses vestibular system responsible for maintaining equilibrium and spatial orientation [12]. The main differential diagnosis of Meniere's disease is vestibular migraine. Some patients meet diagnostic criteria for both of these disorders; this suggests a pathophysiological link between them. Vestibular migraine might lead to a disturbance in the inner ear by way of the trigemino-vascular system, increasing probability of endolymphatic hydrops [13]. Regarding vestibular paroxysmia, the core symptoms are frequently recurring, short attacks of spinning or non-spinning vertigo lasting for seconds to minutes. With at least five spontaneous episodic attacks and response to carbamazepine. The underlying mechanism is assumed to be a pathologic vessel-nerve contact, mostly by the anterior inferior cerebellar artery (AICA), inducing demyelination with succeeding

hyperexcitability enabling ephaptic depolarization [14]. Also, the main manifestations of third mobile window syndromes are recurrent attacks of vertigo induced by changes in intracranial/middle-ear pressure or loud noises, autophony, increased bone conduction, and/or pulsatile tinnitus.

Superior semicircular canal dehiscence is the most common subtype and is caused by a bony defect between superior semicircular canal and the middle cranial fossa creating a third window in inner ear [15].

Chronic vestibular syndrome (CVS) lasts usually months to years and is generally associated with a persistent vestibular system dysfunction (eg, oscillopsia, nystagmus, gait unsteadiness, falls) [7]. Patients with CVS usually recover from acute symptoms and often lack remarkable findings on audio-vestibular tests. This would make diagnosing chronic vestibular syndromes difficult. The International Classification of Vestibular Diseases emphasized the diagnostic criteria for chronic vestibular diseases, including bilateral vestibulopathy (BVP), persistent postural-perceptual dizziness (PPPD), and Presby vestibulopathy (PVP) [16]. Other common diseases in CVS are neoplasms in posterior fossa and chronic psychological or behavioral manifestations of vestibular disorders [17]. Bilateral vestibulopathy is a condition caused by reduced or absent function of both peripheral vestibular sensory organs and/or nerves.

More than 20 different etiologies have been identified including ototoxic medication, bilateral Meniere's disease, neurodegenerative disorders, infectious disease, autoimmune disease, genetic abnormalities, vascular disease, traumatic onset, and congenital. The etiology of BVP is idiopathic in 20% to 51% of cases. Common symptoms include oscillopsia with head movement and imbalance. Individuals with BVP experience difficulty walking in the dark and on uneven surfaces [2]. Persistent postural perceptual dizziness (PPPD) is a functional vestibular disorder that is characterized by persistent dizziness and/or unsteadiness on most days over a period of 3 months or longer, with the symptoms lasting for hours per day, but not necessarily whole day. The symptoms arise spontaneously but may be worsened by upright posture, active or passive body movements, or exposure to moving visual stimuli. Acute or chronic organic vestibular disorders, neurological or medical illness, or psychological distress may precede these symptoms, appear simultaneously with them, and/or outlast them. The symptoms cause marked functional impairment [18]. Meanwhile, vestibular schwannomas account for 8% of all intracranial tumors and are the most common neoplasm of the cerebellopontine angle in adults.

The most common presenting symptoms include ipsilateral sensorineural hearing loss in more than 90% of patients, dizziness or imbalance in up to 61% and asymmetric tinnitus in 55%. Thin-slice, gadolinium-enhanced MRI of the head is the standard diagnostic approach for the detection of vestibular schwannomas as small as 2 mm in diameter [19]. In 2019 the Classification Committee of the international Bárány Society defined diagnostic criteria for a chronic vestibular syndrome in the elderly aged ≥ 60 years, called presby vestibulopathy. PVP was defined as unsteadiness, gait disturbance, and/or recurrent falls in the presence of mild bilateral peripheral vestibular hypofunction of the vestibulo-ocular reflex (VOR) documented by laboratory findings between normal values and the thresholds established for

BVP [20]. In conclusion, the diagnosis of vestibular symptoms must be carried out as accurately and as quickly as possible so that patient management can be carried out immediately. The international classification of vestibular disorders differentiates vestibular symptoms into vertigo, dizziness, vestibulovisual, and postural symptoms. The clinician must classify the patient's symptoms as vestibular syndrome. So, as soon as the clinicians identify the cause of the vestibular symptoms whether it is dangerous or benign, they can decide on the proper management for the patient [3].

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